CLAIMS

1. A device for recognition of a presented object, such device comprising

a hierarchical memory (HM) in which is stored a data set representative of candidate objects or events, each candidate object or event having one or more features and said data set being arranged as a hierarchical data set having higher level nodes comprising candidate objects or events and lower level nodes corresponding to features of the candidate objects or events, wherein higher level nodes are associated with corresponding lower level nodes and lower level nodes are associated with corresponding higher level nodes;

a front end module (FEM) responsive to a feature of the presented object or event to produce feature detection information;

a selective attention module (SAM), said SAM modulating flow of said feature detection information so as to determine a reduced set of candidate objects or events as potentially corresponding to the presented object or event, said SAM further receiving information from the higher level nodes for effecting said modulating whereby the device selectively attends feature detection information to progressively exclude candidate objects and identify the presented object or event with enhanced efficiency.

2. The device of claim 1, wherein the device responds to successive feature detection information from the FEM to iteratively reduce remaining candidate objects or events and determine a recognition output indicative that:

a) a remaining candidate object or event corresponds to the presented object or event;

b) no candidate object or event matches the presented object or event;

c) a candidate object constitutes a best match to the presented object or event; or

d) a set of candidate objects or events constitutes a best match to the presented object or event.

3. The device of claim 1, wherein the SAM controls gating nodes of the hierarchical data such that one or more detected features excite corresponding nodes at a higher level to maintain active candidate nodes of the hierarchical data set, and the device excludes non-excited nodes from the set of candidate objects to identify the presented object or event.

4. The device of claim 1, wherein the hierarchical data set supports top-down signal flow to derive a measure of feature probabilities.

5. The device of claim 1, wherein a measure is defined on nodes of the hierarchical data set, and the device applies the measure to direct the FEM or modulate feature detection information.

6. The device of claim 1 wherein the device identifies the presented object or event by a candidate object or event represented by a higher level node of the hierarchical data set, wherein each node at the candidate object or event level represents a different candidate object or event; such nodes may be at least partially active or inactive;

wherein an inactive node may indicate, for example, that the corresponding object or event is no longer a candidate object or event;

wherein when the recognition process begins, there is a set of candidate objects or events, as indicated by the activity of the corresponding nodes; as recognition proceeds, nodes at the candidate object or event level become inactive and the corresponding candidate objects or events are excluded; and

wherein recognition may then occur when all but one node at the candidate object or event level has become inactive; e.g., all but one object or event has been excluded.

7. The device of claim 1 wherein the hierarchical data set includes one or more higher levels above candidate objects or events corresponding to object or event category or other type of higher level contextual constraint (respectively, relationships among object or event categories or relationships among other types of higher level contextual constraints);

wherein the recognition device defines a set of active candidate objects or events by object or event category, or other type of higher level contextual constraint;

wherein the device may receive the object or event category, or other type of higher level contextual constraint as a user input to narrow the initial class of candidate objects or events, or the device may operate with one or more category or other type of higher level contextual constraint recognition processes to initially determine the category of active candidate objects or events.

8. The device of claim 1, wherein the hierarchical database contains one or more intermediate levels below the candidate object or event level, an intermediate level representing an object or event in terms of compositional elements.

9. The device of claim 8, wherein compositional elements of a lower level are represented by sub-elements they contain.

10. The device of claim 1, wherein nodes at different levels of the hierarchical data set are connected, in bottom-up fashion, to nodes at a higher level according to a compositional rule whereby lower level nodes representing an element or sub element are connected to nodes at the next higher level if the item represented by that node is composed in part by the element or sub-element.

11. The device of claim 1, wherein bottom-up signal processing is arranged such that detection of a feature causes a corresponding feature node of the data set to excite the nodes of the data set connected to said corresponding feature node, and candidate object or event nodes that do not receive excitation become inactive for the remainder of the recognition process whereby nodes representing candidate objects or events that do not contain detected features are progressively excluded during the recognition process.

12. The device of claim 1, wherein the device applies top-down signal processing at intermediate and feature levels to compute a measure of feature probability from the current subset of (non-excluded) candidate objects or events, for example, by summation at each node of top-down signals (specified by the compositional rule) flowing into that node or by another automated procedure for defining a measure.

13. The device of claim 1, wherein the SAM operates in conjunction with the FEM to detect feature information for a feature that:

a) has a low non-zero measure and is present, or

b) has a high measure and is absent,

whereby when the feature has low non-zero measure, features having zero measure and objects or events containing said features are excluded from the candidate set allowing compact processing.

14. The device of claim 1, wherein the SAM attends to feature information by applying at least one selection process chosen from among the set of processes consisting of:

a) a random selection process;

b) a unidirectional selection process; and

c) a bidirectional selection process (such as "greatest mismatch" for example is detected to be present but has the lowest non-zero probability of being present; or is determined to be not present, but has the highest probability based on the currently active nodes).

15. The device of claim 1, wherein an initial set of candidate objects or events that may, for example, be determined by pre-existing information (such as context) is processed to set measures of feature probabilities before the object or event is presented, and thereafter when the object or event is presented, the FEM detects feature information and the SAM applies said measures to open certain gating nodes, so that bottom-up processing in the hierarchical data set excludes a fraction of the candidate objects or events. A new measure of feature probability may then be computed top-down based on remaining non-excluded candidate objects or events, and cycles may be iterated until recognition occurs when there is only a single candidate object or event a determination is made that no match exists, or a close match is found.

16. A method of identifying a presented object or event by determining a corresponding object or event from among a set of candidate objects or events, such method comprising the steps of:

a) constructing a hierarchical data set wherein the data set includes a level of candidate object or event nodes hierarchically connected with a level of feature nodes;

b) selectively detecting at least one feature of the presented object or event, said feature corresponding to a feature node of the data set; and

c) excluding candidate object or event nodes that are not connected to the feature node corresponding to the selectively detected node so that steps b) and c) reduce the number of candidate objects or events, leading to recognition of the presented object or event.

17. The method of claim 16, wherein said selective detecting is carried out by attending to one or more features based on a feature measure determined from the set of candidate objects or events.

18. The method of claim 16, wherein the features constitute parts of the candidate objects or events, and the feature measure is defined by counting parts corresponding to the set of candidate objects or events and normalizing the counts.

19. The method of claim 16, wherein the selective detecting is carried out by selecting a feature that is determined to be:

i) absent, but have a high measure; or

ii) present but have a low non-zero measure;

so that step c) substantially reduces the set of candidate object or event nodes.

20. The method of claim 16, wherein the candidate objects are chemical or biological formulae.

21. The method of claim 16, wherein the hierarchical data set includes nodes intermediate to the feature nodes and the object or event nodes.

22. A recognition method for identifying a presented stimulus, such method comprising the steps of:

a) presenting an input stimulus for recognition;

b) identifying a set of candidate objects or events, the candidate objects or events possessing features, wherein the candidate objects or events and features form an interconnected hierarchy wherein an object or event node at a higher level is linked to feature nodes at a lower

level corresponding to the object or event node, and wherein a feature node at the lower level is linked to one or more corresponding object or event nodes;

c) assigning a measure to features at the lower level, setting a window of attention identifying feature domain information of interest, detecting a feature in the window of attention, wherein said setting a window of attention is performed responsive to said measure so that processing of the detected feature efficiently reduces the candidate set; and

d) re-defining the set of candidate objects or events consistent with the detection of said feature.

23. The recognition method of claim 22, wherein the steps c) and d) are repeated to iteratively reduce the candidate set to a single candidate, thereby identifying the presented object or event.

24. The recognition method of claim 22, wherein the detection is carried out simultaneously of plural features in plural windows of attention to reduce the candidate set.

25. The recognition method of claim 22, wherein the step of selecting a window of attention is performed by selecting a window including a feature having a high measure or a low non-zero measure.

26. A recognition device comprising a processor, at least one feature detector or input receiving device for receiving a feature detection input, and a hierarchical database having nodes at a lower level corresponding to features hierarchically connected to nodes at a higher level corresponding to candidate objects or events, wherein the processor is operative to carry out processing for identifying a presented object or event by determining a corresponding object or event from among a set of candidate objects or events by implementing the following steps:

a) constructing a hierarchical data set wherein the data set includes a level of candidate object or event nodes hierarchically connected with a level of feature nodes;

b) selectively detecting at least one feature of the presented object or event, said feature corresponding to a feature node of the data set; and

c) excluding candidate object or event nodes that are not connected to the feature node corresponding to the selectively detected node so that steps b) and c) reduce the number of candidate objects or events, leading to recognition of the presented object or event.

27. The recognition device of claim 26, wherein the candidate objects or events are objects or events selected from one of the groups of objects or events including physical objects or events, abstract objects or events and abstract representations of physical objects or events.

28. The device of claim 5, wherein nodes having zero measure are excluded from an active data set thereby enhancing operation by processing a smaller data set.